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The Treatment Effect of Acupuncture to Dysphagia

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Abstract

The study systematically reviews currently available studies which investigate the treatment effect of acupuncture in treating dysphagia. The review also gives a general picture of the characteristics of currently available studies conducted, so as to suggest directions for future clinical studies of this alternative treatment method for treating dysphagia. Sixty published research papers in Simplified Chinese were collected. Eighteen of the collected papers were analyzed. The result of meta-analysis showed positive treatment effect of acupuncture to dysphagia. Future research projects should focus on 1) Non-Chinese population 2) Patients with dysphagia originated from causes other than neurological damage, for example, degenerative diseases 3) Using instrumental swallowing assessment as parameter of outcome measure. Potential bias and limitations of the meta-analysis were discussed.

Dysphagia

Dysphagia is the medical term to describe swallowing difficulty or painful experience during swallowing (Medline Plus, 2010). Dysphagia occurs upon any swallowing related structural or neurological deficits (Medline Plus, 2010). Structural deficits refer to deformation or malfunction of the structures, for example, cleft palate, weakened or damaged tongue muscles. Neurological deficits can be of two types They are classified by their nature of occurrence: 1) Condition that occurs suddenly, in which the patient can be expected to have certain degree of recovery, such as, stroke, head trauma, post-treatment trauma from chemoradiation treatment for head and neck cancer, or spinal cord injury; 2) Conditions which are degenerative in nature, in which gradual deterioration in swallowing ability over time is anticipated. They are Parkinson's Disease, Alzheimer's Disease, Multiple Sclerosis, or Myasthenia Gravis (Logemann, 1998). Dysphagia suggests a poor prognosis to general health (Paciaroni, Mazzotta, Corea, Caso, Venti & Milia, 2004). Dysphagia reduces the capability of food intake of patients, resulting in malnutrition. Dysphagia also increases the risk of chest infection as aspiration (food bolus going down into the lungs) would have a high risk leading to aspiration pneumonia. More than half of the patients with pneumonia presented signs of oropharyngeal dysphagia (Cabre, Serra-Prat, Palomera, Almirall, Pallares & Clave, 2010). Hence, dysphagia increases the risk of persistent disability, prolonged hospital stay, and increases mortality (Paciaroni et al., 2004).

Treatment to dysphagia nowadays may involve therapy procedures and compensatory techniques (Logemann, 1998), gastrointestinal nutrition, medication and surgery. Therapy procedures aim to improve the physiology of swallow (Logemann, 1998). Therapy includes therapeutic neuromuscular stimulations like VitalStim therapy and Deep Pharyngeal Neuromuscular Stimulation (DPNS), the training of mastery of the swallowing maneuvers and oral-motor exercises. Therapy could be either direct or indirect, depending on the swallowing ability of individual patient (Logemann, 1998). Direct therapy involves presenting food or liquid to the patient and asking him or her to swallow it while following specific instructions. Indirect therapy involves using techniques which stimulate or exercise parts of the anatomy involved in the swallowing process with the absence of food or liquid (Hardy & Robinson, 1999). Compensatory techniques are designed to control the flow of food and eliminate symptoms (Logemann, 1998). Unlike the therapy procedures, it does not necessarily alter the physiology of swallow (Logemann, 1998). It involves modification of the swallowing posture, modification of feeding amount, volume and environment, modification of food consistency and the use of intraoral prosthetics (Logemann, 1998).

Acupuncture

Acupuncture has been widely used for treating dysphagia in China for its recognition being a safe and low-cost alternative treatment approach (Xie, Wang, He, & Wu, 2008). In Traditional Chinese Medicine (TCM), dysphagia is categorized as radix lingua disease after

‘wind stroke’, ‘yinfei’, and larynx obstruction, and is characterized by local symptoms in the mouth, tongue, pharynx, and larynx.

The mechanism of acupuncture for dysphagia is still unknown (Xie et al., 2008). Acupuncture is generally presumed that it contributed by stimulating the muscles and nerves with deficits and improving blood supply, which might aid the recovery of patient with dysphagia of traumatic origin (Xie et al., 2008). For example, vertebrobasilar blood supply, blood rheology and blood microcirculation are improved by acupuncture in pseudobulbar palsy (Jiang, Shi, Zhang, Hu & Liu, 1992). Acupuncture could also regulate the swallowing reflex by altering regional brain activity (Seki, Kurusu, Tanji, Ariai & Sasaki 2003).

Despite the unclear underlying medical principle, there are many studies supporting the positive treatment effect of acupuncture on dysphagia. Different acupuncture methods, including body acupuncture, scalp acupuncture, tongue acupuncture, ear acupuncture, neck acupuncture, abdominal acupuncture, electroacupuncture, eye acupuncture, wrist-ankle acupuncture, cutaneous needle and moxibustion with warming needle, were reported to be effective in treating dysphagia (Ho & Ho, 2008; Chen, 2004). The treatment effect measured by bedside assessment of swallowing has been reported to be as high as 80% to 100% (Nowicki & Averill, 2003). Studies using instrumental methodology for treatment outcome evaluation, videofluoroscopic study of swallowing studies (VFSS), also showed positive treatment effect (Zhong, Rong, He & Jin, 2003). It was reported that acupuncture is effective

in the prevention of aspiration and aspiration pneumonia (Seki, Iwasaki, Arai, Sasaki, Hayashi, Yamada & Toba, 2005) in post-stroke patients. Acupuncture is also documented to be effective in treating dysphagia caused by cerebral trauma (Zou & Zhao, 2004), motor neuron disease (Zhao, 1997) and digestive system disease (Zhao & Zhang, 2001). Improvement in swallowing performance was reported in post-chemoradiation therapy head and neck cancer patient following acupuncture treatment (Lu, Posner, Wayne, Rosenthal & Haddad, 2010). However, a recent systematic review on the treatment effect of acupuncture for dysphagia in acute stroke patients concluded that it lacks methodologically-sound evidence (high quality and large scale randomized control trials) to conclude acupuncture has a positive therapeutic effect (Xie et al., 2008). This review aims to review systematically currently available literature, to examine the effectiveness of acupuncture in treating dysphagia. The review also gives a general picture of the characteristics of currently available studies conducted, so as to suggest directions for future clinical studies of this alternative treatment method for treating dysphagia.

Method

Data Collection

Electronic Databases

Access to various electronic databases is available through the library search engine of the University of Hong Kong (HKU Dragon). It allowed the researcher to access electronic version of published journal articles in both English and Chinese.

Databases accessible through HKU Dragon:

- MEDLINE
- ProQuest Digital Dissertations
- PubMed
- ISI web of science
- 中文生物醫學期刊文獻數據庫
- 中國期刊網,
- CM online：中医药在线

Electronic databases open to public:

- The Cochrane Library by the Cochrane Collaboration
- PubMed Central by the United States National Institutes of Health
- Google Scholar (search engine)

Search keywords used (English): Acupuncture, Dysphagia, Swallowing

Search keywords used (Chinese): 針灸、吞嚥困難、吞嚥障礙、吞嚥

Cross Referencing from published studies

The reference lists in published papers were further identified for relevant studies.

Unpublished Studies

Listings of unpublished or ongoing studies were noted in the search of the published studies on the internet. Details of the research were obtained through contacting the corresponding researchers.

Data Selection

Primary Screening

Including studies inadvertently more than once in a meta-analysis could introduce substantial biases, therefore it is important not to analyze duplicate publications (reports describing the same study) (Tramèr, Reynolds, Moore & McQuay, 1997). Primary screening aims to identify duplicate publications and link them as one study. The following information was extracted and compared among the searched literatures:

1. Author names
2. Year of publication
3. Location and setting
4. Number of participants and baseline data
5. Parameters of research outcome measure

Secondary Screening

Secondary screening aims to further narrow down the data in respect to the relevance and quality of the studies. Two researchers, the author of this paper and a peer researcher, Lee Hau Kit, an undergraduate student in his final year of the degree of Bachelor of Science in Speech and Hearing Sciences of the University of Hong Kong, worked independently in this screening process.

Part 1: Relevance

Titles and abstracts were examined for judging the relevance of the studies. Studies were classified into relevant or irrelevant. Judgment was made independently by the two researchers. After that, a discussion was held to settle any disagreements concerning the relevance of each study.

Part 2: Quality

The quality, quantity and consistency of studies vary. They constitute the level of evidence. The level of evidence was graded by an objective grading scale, The Oxford 2011, Levels of Evidence. It classifies the studies into five levels (see Appendix 1) (OCEBM Levels of Evidence Working Group, 2011). Only studies graded with level 2 or above were included (see Appendix 1).

Formal measure of agreement was done to describe the inter-tester reliability of data selection by the two researchers. Agreement between the two researchers in this screening process was shown by calculating the Cohen's kappa coefficient (Kappa):

Suppose K studies are distributed according to number a to i as in Table 1

Table 1

Data for calculation of Cohen's kappa coefficient

		Researcher 2			
		Include	Exclude	Unsure	Total
Researcher 1	Include	a	b	c	I_1
	Exclude	d	e	f	E_1
	Unsure	g	h	i	U_1
	Total	I_2	E_2	U_2	K

Then,

$$\text{Kappa} = \frac{P_o - P_E}{1 - P_E}$$

where,

$$P_O = \frac{a + e + i}{K}$$

is the proportion of studies for which there was agreement, and

$$P_E = \frac{I_1 \times I_2 + E_1 \times E_2 + U_1 \times U_2}{K^2}$$

is the proportion of studies in which one would expect there to be agreement by chance alone.

Table 2

Meaning of kappa value (Orwin, 1994)

Kappa value	Respective meaning
0.40 - 0.59	Fair agreement
0.60 - 0.74	Good agreement
≥ 0.74	Excellent agreement

Data Analysis

Description on the characteristics of currently available relevant studies

Statistics on the distribution of all relevant studies (all studies which has proceeded to part 1 of the secondary screening process) in respect to the following areas was obtained:

1. Quality of study

Strength of evidence

It was graded by The Oxford 2011, Levels of Evidence.

2. Year of study
3. Clinical characteristics (cause of dysphagia) of participants
4. Parameter of research outcome measure

Analysis on the treatment effect

Meta-analysis was used to statistically combine the results of all included studies. The first step was to find out the types of data the included studies used to quantify the swallowing ability or the treatment effect to it. The types of data used in the studies determine the methodology for the meta-analysis. It was found that all data presented by the included Chinese studies were ordinal data. As the ordinal data were not given according to the same rating principle, the data were converted into dichotomous data after careful examination of the rating system in the studies (Higgins & Green, 2008). Proportional odds model (ordinal logistic regression) was used to analyze the converted data. Assumed there is an equal odds ratio for both dichotomies of the data. Therefore, the odds ratio obtained could be interpreted as the odds of success on the group with experimental intervention relative to the control group. From the model, estimates of log odds ratios (Y) and their standard errors (SE) of each study were obtained. They were then meta-analyzed using the generic inverse-variance method (fixed-effect).

The generic inverse-variance method:

$$\text{The overall weighted average of estimates} = \frac{\sum \mathrm{Y}(\frac{1}{\mathrm{SE}^2})}{\sum(1/\mathrm{SE}^2)}$$

The overall weighted average of odds ratio on the experimental groups to the control groups was obtained in the end to determine the overall treatment effect. The odds ratio was converted into Risk in percentage for easy interpretation in the end. Risk describes the probability with which an outcome (in this case positive treatment effect) will occur.

Results

Data collection

Sixty published studies (Details were shown in Appendix 2) were gathered from electronic databases, in which five of them were in English (8.3%) and the rest of them were in Simplified Chinese (91.7%). No unpublished literature was found.

Data selection

Two sets of duplicated reports in Simplified Chinese were found in the primary screening. They were found to be exactly the same study, having identical research background, published on different journals. Therefore, 58 studies proceed to the secondary screening process.

Two researchers worked independently in the secondary screening. Among the fifty eight studies, 13 of them were discarded due to their irrelevance in part 1. In part 2, 24 of the 45 studies were discarded due to low level of evidence (lower than level 2 in CEBM 2011). Three of the 21 studies were later discarded in the analysis process due to inadequate information. In the end, a total of 18 studies in Simplified Chinese were included in the meta-analysis. Table 3 shows the preference of the two researchers in the process.

Table 3

Result of secondary screening by two researchers

		Researcher 2			
		Include	Exclude	Unsure	Total
Researcher 1	Include	18	7	0	25
	Exclude	1	32	0	33
	Unsure	0	0	0	0
	Total	19	39	0	58

Agreement by the two researchers (by simple kappa statistic):

$$P_O = \frac{18 + 32 + 0}{58} = 0.862$$

$$P_E = \frac{25 \times 19 + 33 \times 39}{58^2} = 0.524$$

$$\text{Kappa} = \frac{P_o - P_E}{1 - P_E} = \frac{0.862 - 0.524}{1 - 0.524} = 0.71$$

According to table 2, the agreement was good.

Data analysis

Description on the characteristics of the currently available relevant studies

There were a total of 45 relevant studies (studies which proceeded to part 2 of the secondary screening). Five characteristics of the studies were summarized in the tables below. (Table 4 to Table 7)

1. Study quality (Level of evidence)

Table 4

Distribution of level of evidence of relevant studies

Level of evidence (CEBM 2011)	No. of studies
1	0
2	23
3	0
4	16
5	6
Total	45

Studies were mainly on level 2 and level 4.

2. Year of study

Table 5

Distribution of year of study

Year	Number of study
1988	1
1996	1
2003	1
2004	3
2005	6

2006	5
2007	5
2008	19
2009	2
2011	1
Total	44*

*There was one study did not specify the year when it was undertaken.

Studies were published annually since 2003 and the number of studies published started to increase. In 2008, a dramatic large number of studies were published.

3. Clinical Characteristics

Table 6

Distribution clinical characteristics of participants in the studies

Clinical characteristic	Number of study
Cancer	3
Neurology	34
Traumatic	1
Mixed	1

*There were six literature review papers with no participants.

The majority of the studies examine the treatment effect of acupuncture to dysphagia with neurological origin.

4. Parameter of research outcome measure

Table 7

Distribution of parameter of research outcome measure

Parameter	Number of study
Bedside swallowing assessment	32
Videofluoroscopic swallowing study	5
General clinical description	2
Total	39*

*There were six literature review papers with no clinical trials.

The majority of the studies used bedside swallowing assessment with either a post-treatment bedside swallowing assessment scoring system or an arbitrary rating scale coined by the respective researcher for that particular research, as clinical description.

Analysis on the treatment effect

Meta-analysis

There were 18 studies included after the primary and the secondary screening process. The following table shows the characteristics of each included studies.

Table 8

Characteristics of included studies

Study code	Study design	No. of subjects	Clinical characteristics	Year of study	Level of evidence	Outcome measure
1	RCT	93	CVA	2006	2	Bedside
2	RCT	96	CVA	2008	2	Bedside
3	RCT	60	CVA	2008	2	Bedside
4	RCT	60	Pseudobulbar palsy	2006	2	Bedside
5	RCT	95	CVA	2006	2	Bedside
6	RCT	82	CVA	2008	2	Bedside
7	RCT	86	Pseudobulbar palsy	2007	2	Bedside
8	RCT	60	Pseudobulbar palsy	2008	2	Bedside
9	RCT	75	CVA	2005	2	Bedside
10	RCT	40	CVA	2008	2	Bedside
11	RCT	80	CVA	2008	2	Bedside
12	RCT	60	CVA	2004	2	Bedside
13	RCT	115	CVA	2008	2	VFSS
14	RCT	66	CVA	2008	2	Bedside
15	RCT	197	Pseudobulbar palsy	2008	2	Bedside

16	RCT	120	CVA	2008	2	Bedside
17	RCT	60	CVA	2008	2	Bedside
18	RCT	80	Mixed	2009	2	Bedside

*RCT = Randomized-control trial, VFSS = Videofluoroscopic swallowing study, CVA = Cerebral-vascular accident, Bedside = Bedside swallowing assessment

It was found that all data presented by the included studies were ordinal data. For most of the studies, patients were classified into three to four categories of treatment effect, for example, cured, effective, and ineffective according to the different scoring/rating system in each study. As the ordinal data were not given according to the same scoring/rating system, the data were converted into dichotomous data after careful examination of the rating system in the studies. The table in Appendix 3 shows the converted data of each study. The data was analyzed by proportional odds model (ordinal logistic regression), estimates of log odds ratios and their standard errors of each study were obtained as shown in Appendix 3. Generic inverse-variance method (fixed-effect) was used to analyze the estimates of log odds ratios and their standard errors of each study. The overall weighted average of estimates on the experimental groups to the control groups was obtained to determine the overall treatment effect. The overall weighted average of estimates $= \frac{\sum Y(\frac{1}{SE^2})}{\sum(1/SE^2)}$

The overall weighted average of estimates = 1.592109

Overall odds ratio = 4.419 : 1

It was converted to Risk for easy interpretation.

Risk (the probability for positive treatment outcome)

For intervention group: 83.1% **For control group: 50%**

The treatment outcome of using acupuncture for dysphagia is positive with statistical support.

Discussion

The study of this paper consists of two parts: 1. To summarize the currently available relevant research papers so as to have a better picture of the progress of the research on the topic, and 2. To analyze whether or not acupuncture has a treatment effect to dysphagia. Acupuncture is a medical technique from traditional Chinese medicine. It has a long history of usage and was believed to be effective in treating diseases in a number of clinical research studies. The treatment approach, however, was new to the international medical community. This was evidence by the very small fraction of currently available research paper published in English comparing to the much larger numbers published in Simplified Chinese. It only has five research papers in English concerning the treatment method, which is an exceptionally small number when it was compared to the abundant search results of other treatment methods (not acupuncture) to dysphagia. That implied the international medical community has just started to look into this remedy. Evidence-based medicine, on the other hand, is a new concept to the medical community in Mainland China. Relevant research papers in earlier years were in general of lower quality regarding their level

of evidence. They were mainly case series studies or even case description reports with mechanism-based reasoning, trying to prove the treatment effect of acupuncture. The use of randomized-control trial, a stronger research design in terms of its level of evidence was not found in the related research topic until the year 2004. Since 2005, search reports using randomized-control trial were published almost annually. Despite the fact that acupuncture has a long history being used by traditional Chinese medicine doctors in Mainland China, scientific prove to this ancient remedy's treatment effect was not sought until the year 2004. The abundant research reports in simplified Chinese rather than in English, however, slow down the research progress. It was not easy for non-Chinese researchers to gain access to the research papers published in simplified Chinese. It was not solely a translation problem. Discrepancy in the definition of terminology was also a problem. The Chinese and the other community would not be able to work hand in hand efficiently. It is more likely to result in parallel development of the two languages medical community. In addition, most of the currently available research papers describe Chinese as the target population. One of the suggested future research directions is to test acupuncture's treatment effect on population other than Chinese.

Judging from the summary of clinical characteristics of participants in relevant research papers, the majority of the subjects were patient with dysphagia with neurological origin, neurological damage to be specific (Cerebral-vascular accident & pseudobulbar palsy).

That might suggest acupuncture is, even if it is proven, effective to recover neurological damage caused by suddenly occurring conditions. Studies concerning its treatment effect on dysphagia in other causes degenerative diseases as well as by structural deficits were few which suggests a direction for researcher to go into for future research projects.

The major method for research outcome measure in the currently available relevant studies was bedside swallowing assessment. For most of the studies, patients were classified into three to four categories of treatment effect, for example, cured, effective, and ineffective. The classification was made according to results from either a post-treatment bedside swallowing assessment scoring system or an arbitrary rating scale coined by the respective researcher for that particular research, as clinical description for outcome measure. The validity and reliability of such research papers was doubted as their research findings solely depend on the clinical observation of the researcher as well as each respective rating scale/scoring system. In addition, without an objective and generally agreed method of outcome measure increases the difficulty for cross-study comparison, referencing and review. Latency time in swallowing reflex (LTSR), a continuous measurement used in videofluoroscopic swallowing study by two relevant research papers from Japanese researchers suggested a good objective parameter of outcome measure for future research, as it minimized the random error depending on individual testers, thus improving reliability.

According to the result from the meta-analysis, acupuncture has a positive treatment effect on dysphagia. The majority of the research was having post cerebral-vascular accident Chinese patients as research participants. That could not be generalized into patients with other etiology of dysphagia, such as degenerative diseases until further research has been done.

A number of reporting biases played a role in reducing the validity of the findings of the meta-analysis. Publication bias, the research papers which suggest a beneficial intervention effect are more likely to be published than reports with no significant findings. Unpublished papers are practically more difficult to be accessed than published papers. That suggests, it is possible for the review to have only included mainly studies with positive intervention effect while missing reports stating adverse effect of the intervention. This was suspected in this review project as there was no paper stating non-beneficial result. On the other hand, as acupuncture was originated from traditional Chinese medicine, it was expected most research papers on acupuncture would be published locally in China. Data collection of this project relies heavily on electronic databases and the degree of digitalization of scientific articles in China may not be as high as in the western countries. There was a high probability that many papers that were not published in electronic format were missed. Duplicate publication bias could also be one of the factors reducing the validity of the review. Although two pairs of duplicated research reports were identified in the primary screening, there were cases reported by systematic review authors that two articles reporting the same trial do not

share a single common author (Tramèr, Reynolds, Moore & McQuay, 1997). In common practice, review author would contact the researchers of each study one by one to obtain detailed information of the study to minimize the chances for this occur. However, in the case of this review project, it was difficult limited by manpower and time. Outcome reporting bias, refers to a range of outcome measures that were recorded, however, not reported in the research paper. The choice of outcomes reported may be influenced by the result, so as to making the findings more significant. This serves a potential making published result misleading. Other than selection of outcome measures to report, changing the mode of interpretation could also be possible. As the majority of the outcome measures of the included studies were results of bedside swallowing assessment interpreted by arbitrary scoring system/rating scales. It was possible for the researcher to have modified the scoring scale so as to present a seemingly more pleasant result of the study.

Not being able to look into specific treatment method of acupuncture was one of the limitations in this review project. As there were different combination of acu-points and method of acupuncture, it was not possible to conclude a ‘golden method’ for treating dysphagia with acupuncture.

Conclusion

Acupuncture in general has positive treatment effect on Chinese population with dysphagia originated by cerebral tremor (neurological damage). Research on other

populations with different etiology of dysphagia with subjective parameter of outcome measures is recommended as possible future research direction on the subject.

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Oxford Centre for Evidence-Based Medicine 2011 Levels of Evidence

Question	Step 1 (Level 1*)	Step 2 (Level 2*)	Step 3 (Level 3*)	Step 4 (Level 4*)	Step 5 (Level 5)
How common is the problem?	Local and current random sample surveys (or censuses)	Systematic review of surveys that allow matching to local circumstances**	Local non-random sample**	Case-series**	n/a
Is this diagnostic or monitoring test accurate? (Diagnosis)	Systematic review of cross sectional studies with consistently applied reference standard and blinding	Individual cross sectional studies with consistently applied reference standard and blinding	Non-consecutive studies, or studies without consistently applied reference standards**	Case-control studies, or "poor or non-independent reference standard**	Mechanism-based reasoning
What will happen if we do not add a therapy? (Prognosis)	Systematic review of inception cohort studies	Inception cohort studies	Cohort study or control arm of randomized trial*	Case-series or case-control studies, or poor quality prognostic cohort study**	n/a
Does this intervention help? (Treatment Benefits)	Systematic review of randomized trials or *n*-of-1 trials	Randomized trial or observational study with dramatic effect	Non-randomized controlled cohort/follow-up study**	Case-series, case-control studies, or historically controlled studies**	Mechanism-based reasoning
What are the COMMON harms? (Treatment Harms)	Systematic review of randomized trials, systematic review of nested case-control studies, *n*-of-1 trial with the patient you are raising the question about, or observational study with dramatic effect	Individual randomized trial or (exceptionally) observational study with dramatic effect	Non-randomized controlled cohort/follow-up study (post-marketing surveillance) provided there are sufficient numbers to rule out a common harm. (For long-term harms the duration of follow-up must be sufficient.)**	Case-series, case-control, or historically controlled studies**	Mechanism-based reasoning
What are the RARE harms? (Treatment Harms)	Systematic review of randomized trials or *n*-of-1 trial	Randomized trial or (exceptionally) observational study with dramatic effect			
Is this (early detection) test worthwhile? (Screening)	Systematic review of randomized trials	Randomized trial	Non -randomized controlled cohort/follow-up study**	Case-series, case-control, or historically controlled studies**	Mechanism-based reasoning

*** Level may be graded down on the basis of study quality, imprecision, indirectness (study PICO does not match questions PICO), because of inconsistency between studies, or because the absolute effect size is very small; Level may be graded up if there is a large or very large effect size.**

**** As always, a systematic review is generally better than an individual study.**

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Appendix B Characteristics of collected papers

i) Excluded relevant studies

Excluded Studies

Relevant Studies paper code	Author	location	Number of subjects	origin	Year	CEBM	2011 Outcome measure	
天堂 1	Sum	ShangDong	120	oesophagic cancer	1996		4	Bedside
2	Leung	Beijing	2	oesophagic cancer	1988		4	Bedside
English 1	Weidong	Boston	10	Head and Neck cancer	2011		4	Bedside
5	Xie	cochrane	Review	N/A	2008	N/A		N/A
康泉 1	Yeung	Wunzhou	68	CVA	2008		4	Bedside
2	Yik	Wuhan	60	CVA	2009		2	Bedside
3	Li	GuanDong	62	CVA	2005		2	Bedside
4	Bai	HeBei	107	CVA	2007		2	Bedside
5	Sung	HeNan	58	CVA	2005		4	Bedside
7	Cheung	LiaoNing	Review	N/A	2005	N/A		N/A
9	Chan	AnFei	Review	N/A	2004	N/A		N/A
10	Ho	SiQuian	Review	N/A	2008	N/A		N/A
11	Wut	Guangzhou	Review	N/A	2008	N/A		N/A
12	Poon	AnFei	Review	N/A	2008	N/A		N/A
13	Ma	LiaoNing	36	CVA	2007		4	Bedside
19	Wong	LiaoNing	56	CVA	2004		4	Bedside
20	Gao	TinQun	31	CVA	2005		4	Bedside
21	Sung	HeNan	56	CVA	2007		4	Bedside
26	Pang	QuiYeung	40	Pseudobulbar palsy	2005		4	Bedside
27	Fei	TinQun	1	Progressivebulbarpals	2006		4	Bedside
36	Tseng	ZungShan	50	CVA	2006		2	Bedside
39	Sung	TsingDao	1	polyneuropathy	Unknown		4	General clinical description
40	Li	463 Hospital	30	Pseudobulbar palsy	2008		4	Bedside
44	Qui	HeBei	N/A	Pseudobulbar palsy	2007		4	General clinical description
45	Yu	LiaoNing	60	CVA	2007		2	Bedside
46	Ng	NanNing	39	CVA	2008		2	VFSS
49	Wong	ShenZheng	26	Neck injury	2008		4	Bedside

ii) Excluded irrelevant studies

Excluded Studies

Irrelevant Studies	paper code	Author	location	Number of subjects	origin	Year	CEBM 2011	Outcome measure
[redacted]	2	Seki	Japan	12	CVA	2009	2	LTSR
	3	Seki	Japan	32	CVA	2005	2	VFSS
	4	Seki	Japan	41	CVA	2003	4	LTSR
	6	Wu	TinQun	1	CVA	2008	4	Irrelevant
	31	Cheung	Changchun	82	CVA	2008	2	Bedside
	32	Unknown	Unknown	42	N/A	2002	4	N/A
	34	Wong	SiQuian	41	Ischemic CVA	2008	2	Quality of life
	41	Hon	TinQun	64	CVA	2008	2	Bedside
	43	Chan	FuKin	30	CVA	2005	2	Bedside
	48	Chan	JoQung	60	CVA	2008	2	Bedside
	50	Chan	Harbin	65	Ischemic CVA	2008	2	Bedside
	51	Si	TsuiChow	80	CVA	2005	2	VFSS
Others	1	Wei	GuangDong	63	CVA	2005	2	Bedside

iii) Included Studies

Included Studies

	Paper code	Study code	Author	Location	Number of subjects	Clinical characteristics	Year of study	CEBM 2011	Parameter of outcome measure
研究	8	1	Li	HeBei	93	CVA	2006	2	Bedside
	14	2	Bao	Quichow	96	CVA	2008	2	Bedside
	15	3	Ben	ZiGong	60	CVA	2008	2	Bedside
	16	4	Qui	HeBei	60	Pseudobulbar palsy	2006	2	Bedside
	17	5	Qiu	HuBei	95	CVA	2006	2	Bedside
	18	6	Wong	Guangzhou	82	CVA	2008	2	Bedside
	22	7	Wong	Harbin	86	Pseudobulbar palsy	2007	2	Bedside
	23	8	Yeung	Changchun	60	Pseudobulbar palsy	2008	2	Bedside
	24	9	Chow	GuanDong	75	CVA	2005	2	Bedside
	25	10	Chan	Hainan	40	CVA	2008	2	Bedside
	28	11	Yeung	SiQuian	80	CVA	2008	2	Bedside
	29	12	Law	GuanDong	60	CVA	2004	2	Bedside
	30		Law	GuanDong	60	CVA	2004	2	Bedside
	33	13	Sor	TinQun	115	CVA	2008	2	MBS (aux)
	35		Sor	TinQun	115	CVA	2008	2	MBS (scored)
	37	14	Sung	HeBei	66	CVA	2008	2	Bedside
	38	15	Li	HeBei	197	Pseudobulbar palsy	2008	2	Bedside
	42	16	Cho	SiQuian	120	CVA	2008	2	Bedside
	47	17	Sheung	GuanDong	60	CVA	2008	2	Bedside
Other	2	18	Chan	Hainan	80	CVA + TBI + BC	2009	2	Bedside

Table 10 Converted dichotomous data, estimates of log odds ratios and their respective standard error of each study

Study Code	Intervention group		Control Group			
	Treatment Effect (Number of subjects)					
	Positive	Not positive	Positive	Not positive	Estimates of log odds ratio(Y)*	Standard error (SE)
1	52	10	13	18	-1.995	0.501
2	40	10	29	17	-0.852	0.467
3	14	6	16	14	-1.276	0.584
4	29	2	16	13	-2.467	0.821
5	46	4	19	26	-2.756	0.602
6	31	11	18	22	-1.237	0.473
7	32	12	14	28	-1.674	0.471
8	27	3	18	12	-1.792	0.714
9	27	11	15	22	-1.386	0.493
10	15	5	8	12	-1.504	0.689
11	37	3	31	9	-1.276	0.71
12	23	7	13	17	-1.458	0.568
13	44	12	38	21	-0.706	0.424
14	32	1	25	8	-2.326	1.094
15	91	8	47	51	-2.513	0.421
16	54	6	42	18	-1.35	0.514
17	28	4	18	10	-1.358	0.664
18	33	7	15	25	-2.061	0.529